Low Reconstructed Energy EM Calorimeter Cluster Studies

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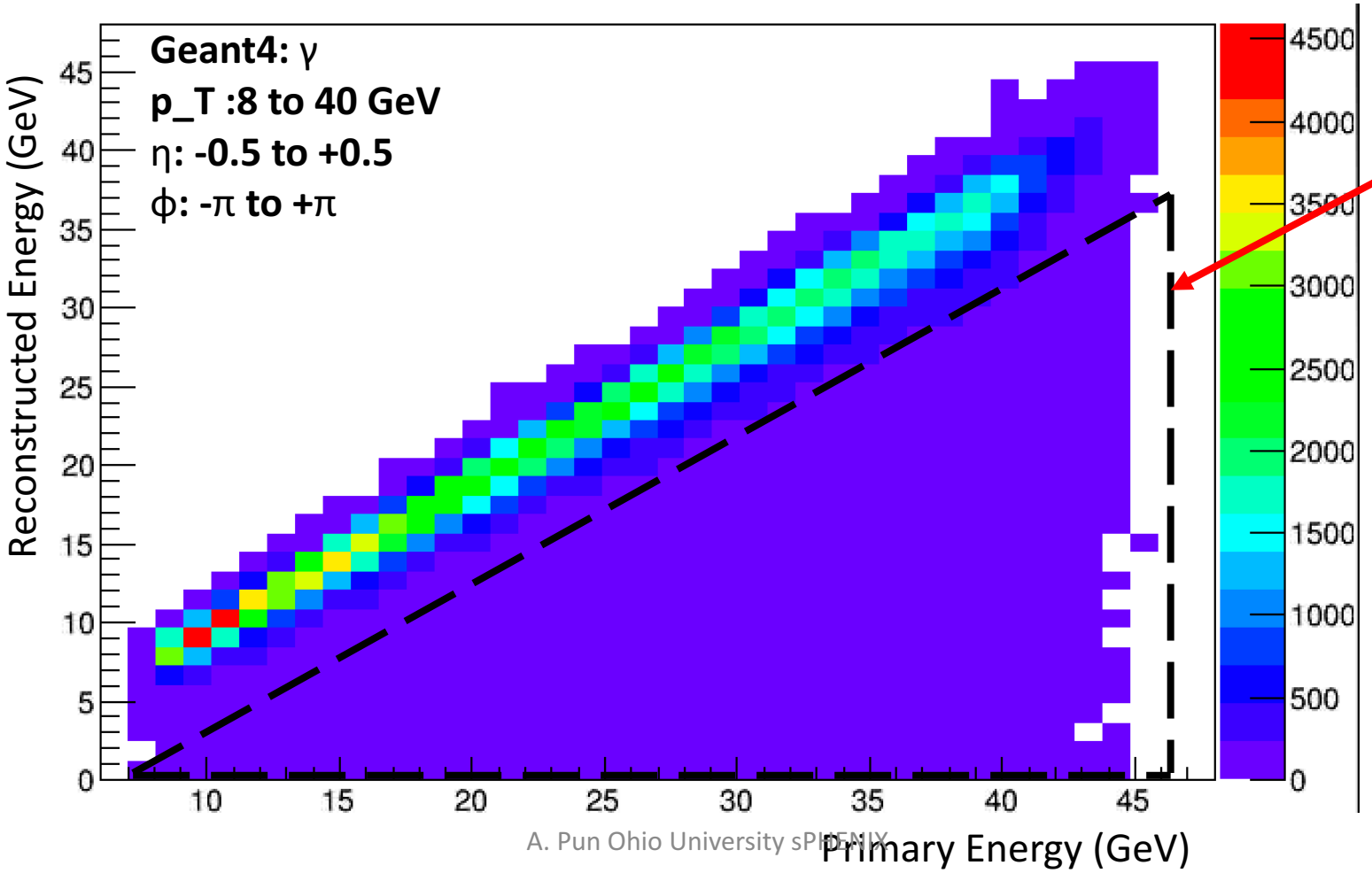
Truth Energy vs Reco Energy

-Along with our studies of EMCal clustering algorithms, we've been generating some general performance plots.
-Before we were focused on cluster splitting performance, mostly with π^0
-Saw these low Ereco clusters as soon as we ran modest γ statistics (since ~December): for all clustering algorithms, all simulation conditions (HIJING embed, particle gun, etc…)

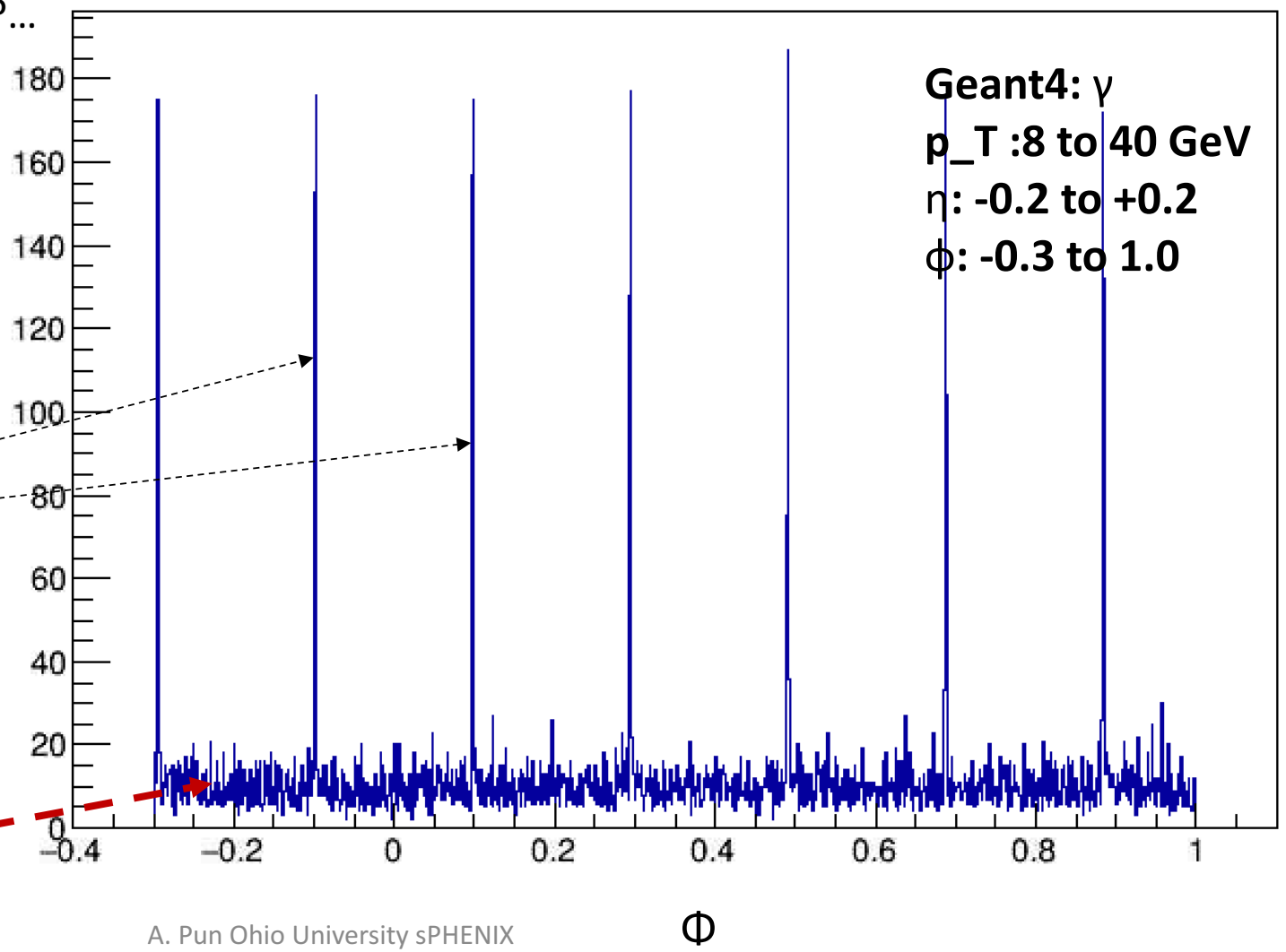


Triangle of low Reconstructed Energy clusters

Generally these counts amount to around 5-10% of all clusters when we looked over whole calorimeter

Pattern of low reconstructed clusters in phi

-We've been focused on classifying where these low E clusters originate.
-Various "large" geometric patterns were visible with different views, some that matched with tower boundaries/possibly sector boundaries, etc?…



$2(\mp\eta)\times 32(\emptyset) = 64$ **Sectors**

$\frac{2\pi}{32} \approx$ **0.2**

Is this pattern due to sector boundary?

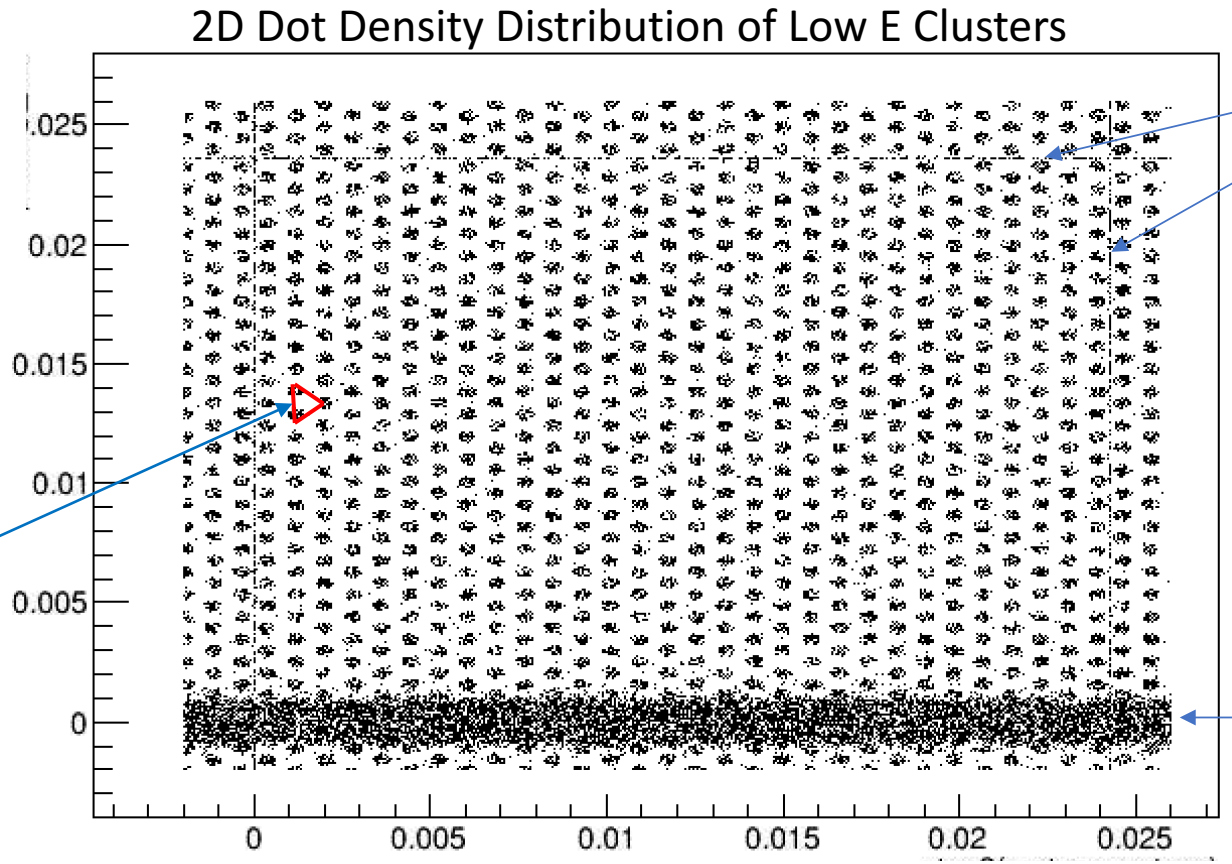
How about these?

Patterns of low reconstructed energy cluster in a tower

-Much larger density of statistics revealed fiber pattern
-Confirmed from rudimentary understanding of 2D spacal geometry construction

Geant4: γ
p_T :8 to 40 GeV
η: **-0.002 to +0.026**
ϕ: **-0.002 to +0.026**

No of fibers in a tower:
$\eta \times \phi = 24 \times 15$



Tower Boundary

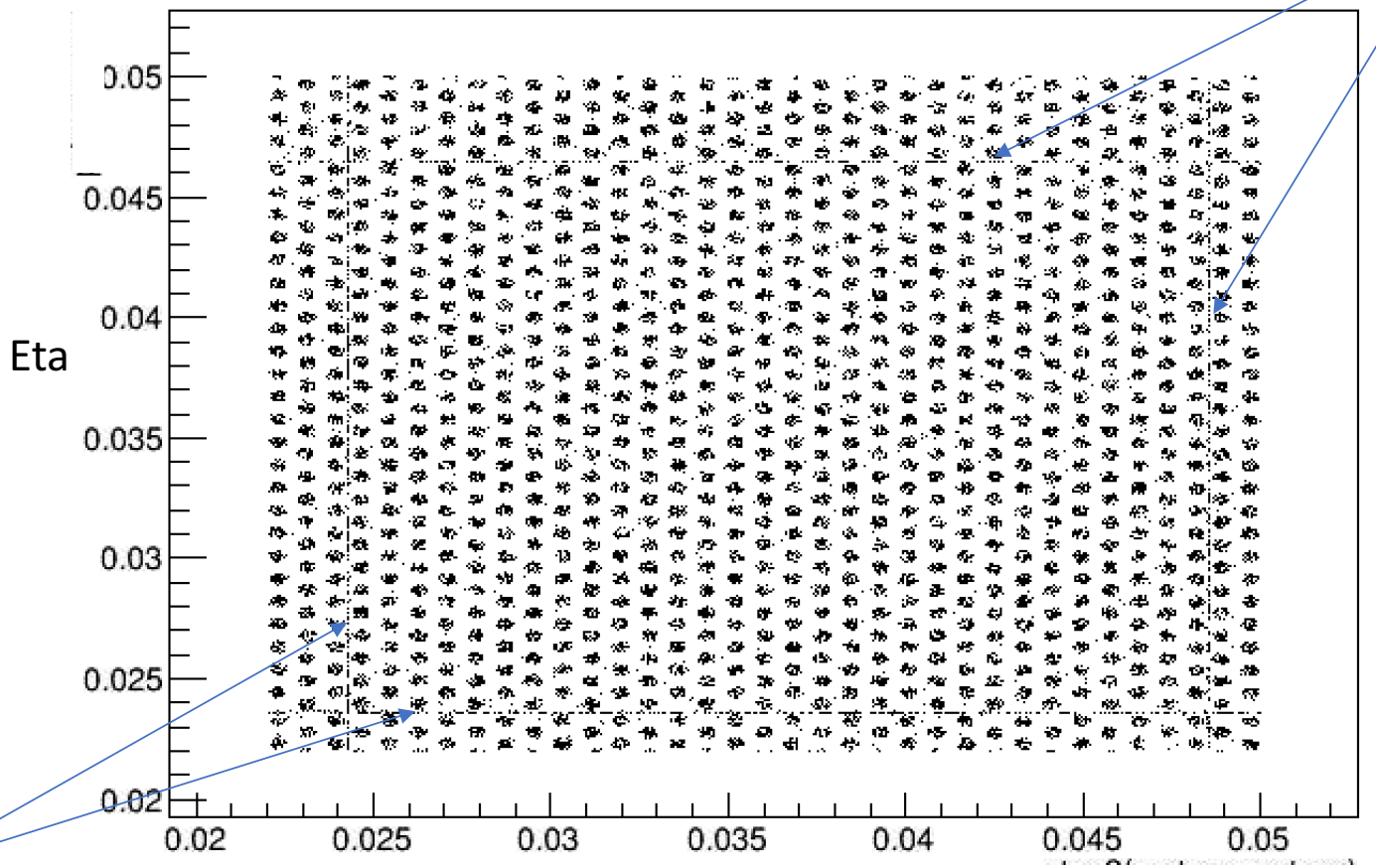
Fibers in triangular pattern

Sector Boundary

Patterns of low reconstructed energy cluster in a tower

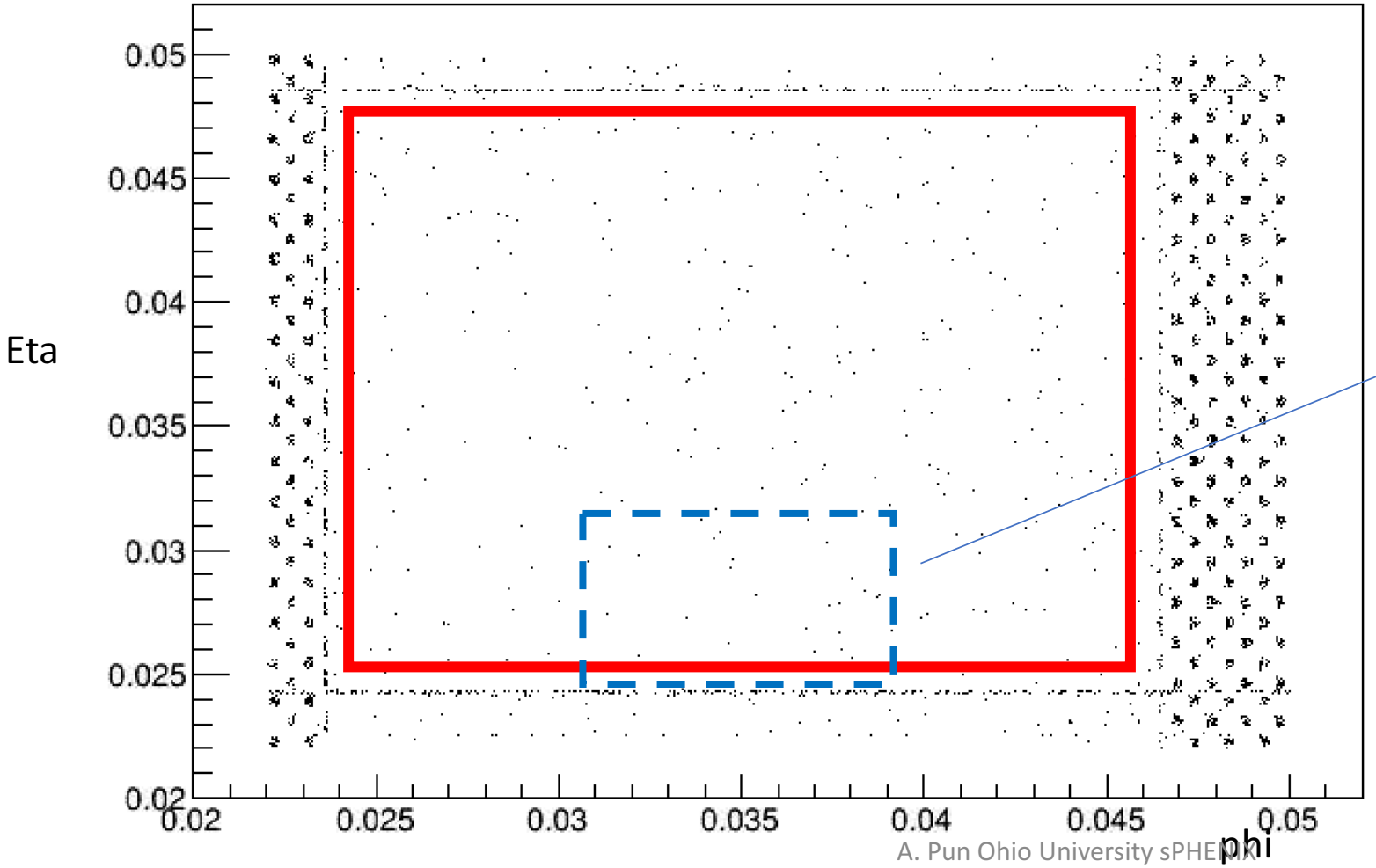
Geant4: γ
p_T :8 to 40 GeV
η: 0.022 to 0.05
ϕ: 0.22 to 0.05

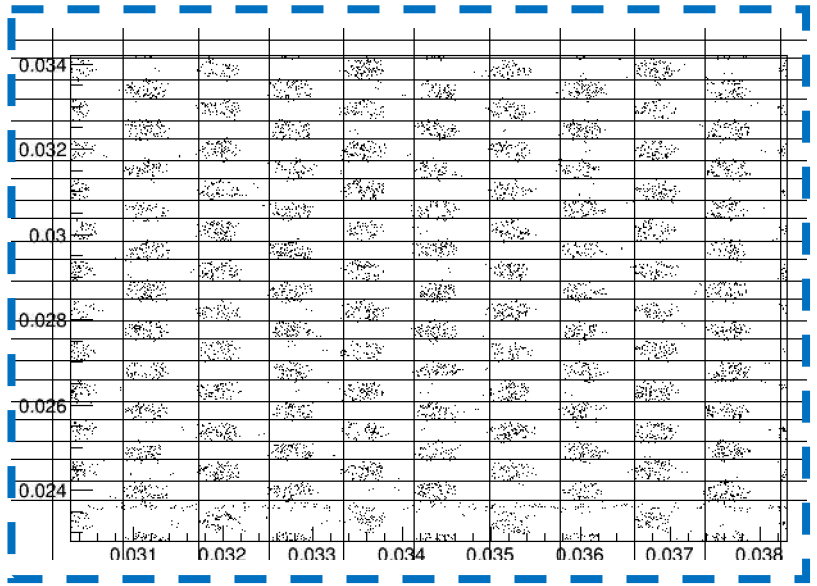
No of fibers in a tower:
$\boldsymbol{\eta \times \phi = 24 \times 15}$



Exclusion of Photons Hitting Geometric Locations of Fibers

-Developed simple algorithm to exclude photons which it fiber locations
-See how/performance changes
-For plots that follow, focus on a **single tower** at $[\eta, \phi] \approx$ [0.03,0.03]
Some Low E Clusters still remain

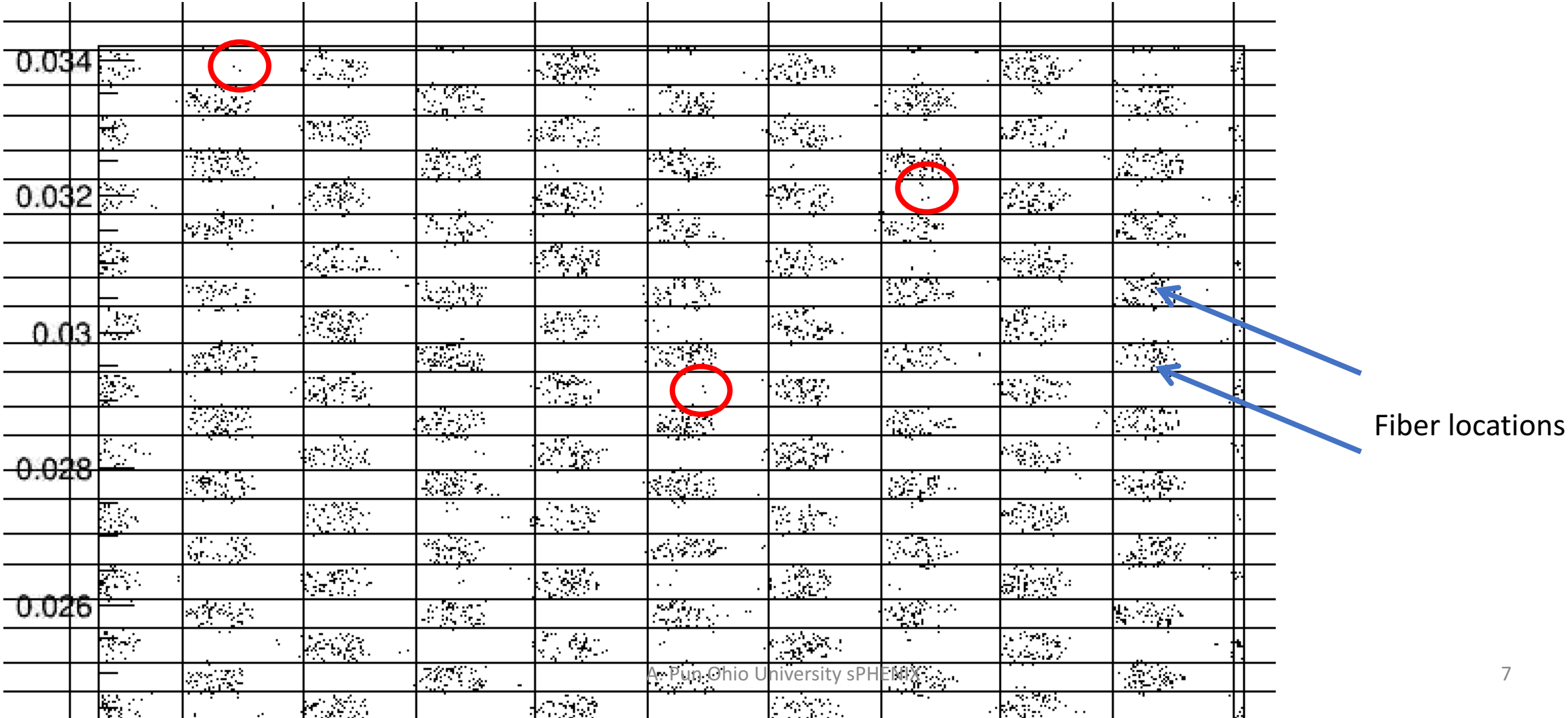




Zoom in without any clusters excluded --see next slide

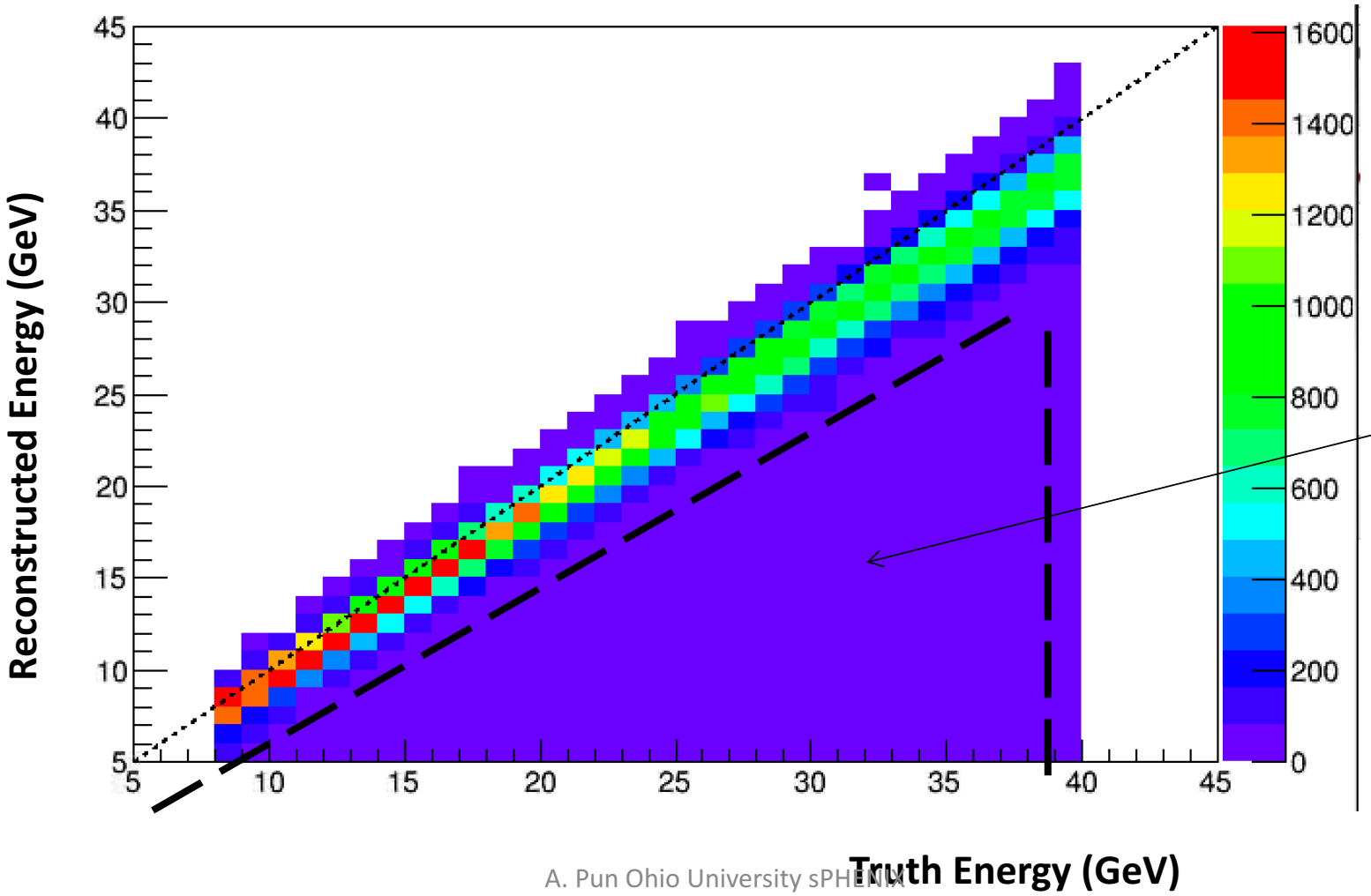
Zoom in: Low E Cluster Locations

-Some Low E clusters not pointing at fiber locations, these remain after geometrical exclusion cuts applied to performance plots that follow



Clusters over one tower (without cut)

Geant4: γ
p_T :8 to 40 GeV
η: 0.025 to 0.047
ϕ: 0.025 to 0.047

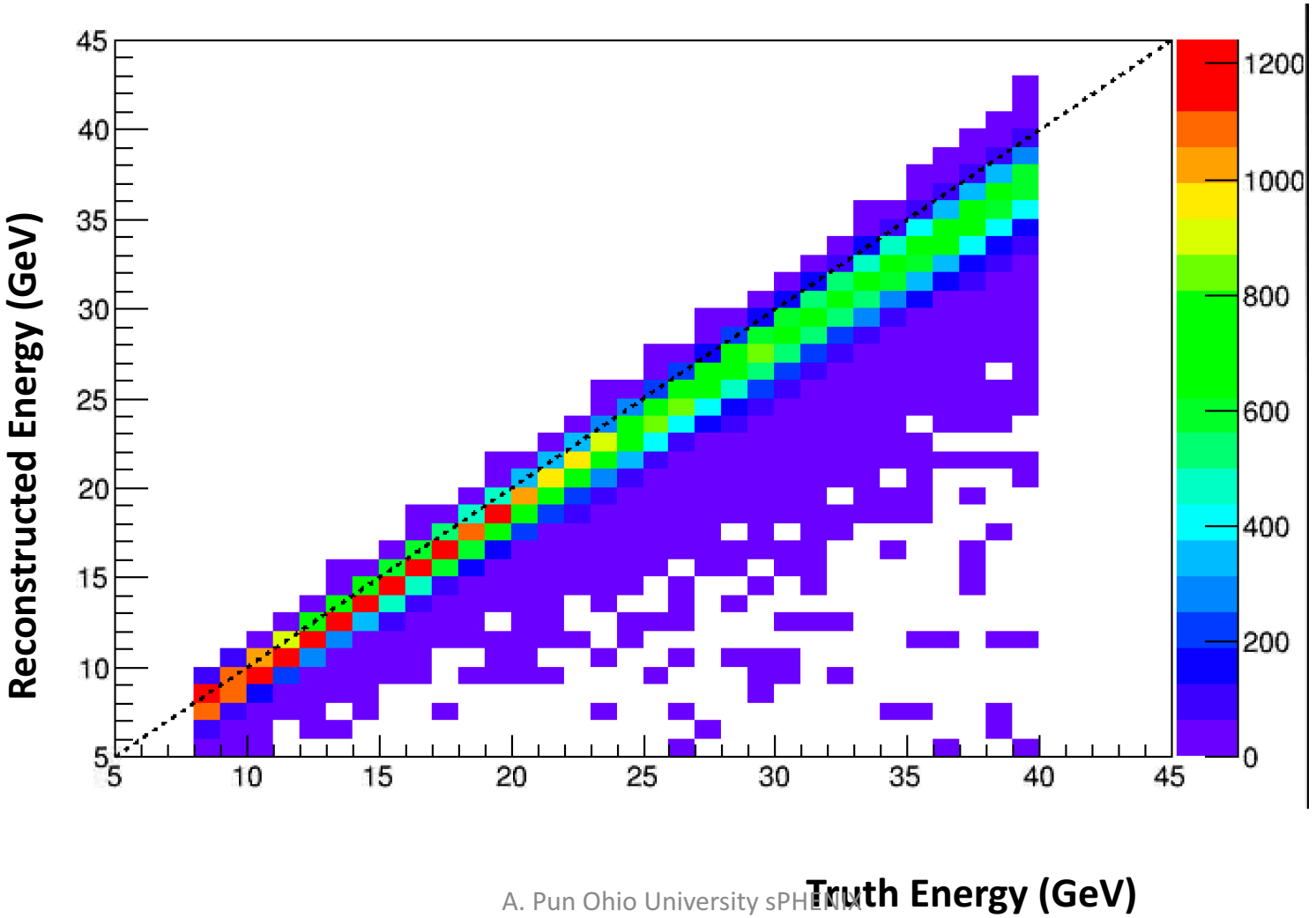


For this tower location (?) the low E clusters at high E_{truth} are **15%** of the total

We think this may be higher than when averaged over larger calorimeter areas

Cluster over one tower
(with fiber exclusion cut)

Geant4: γ
p_T :8 to 40 GeV
η: 0.025 to 0.047
ϕ: 0.025 to 0.047



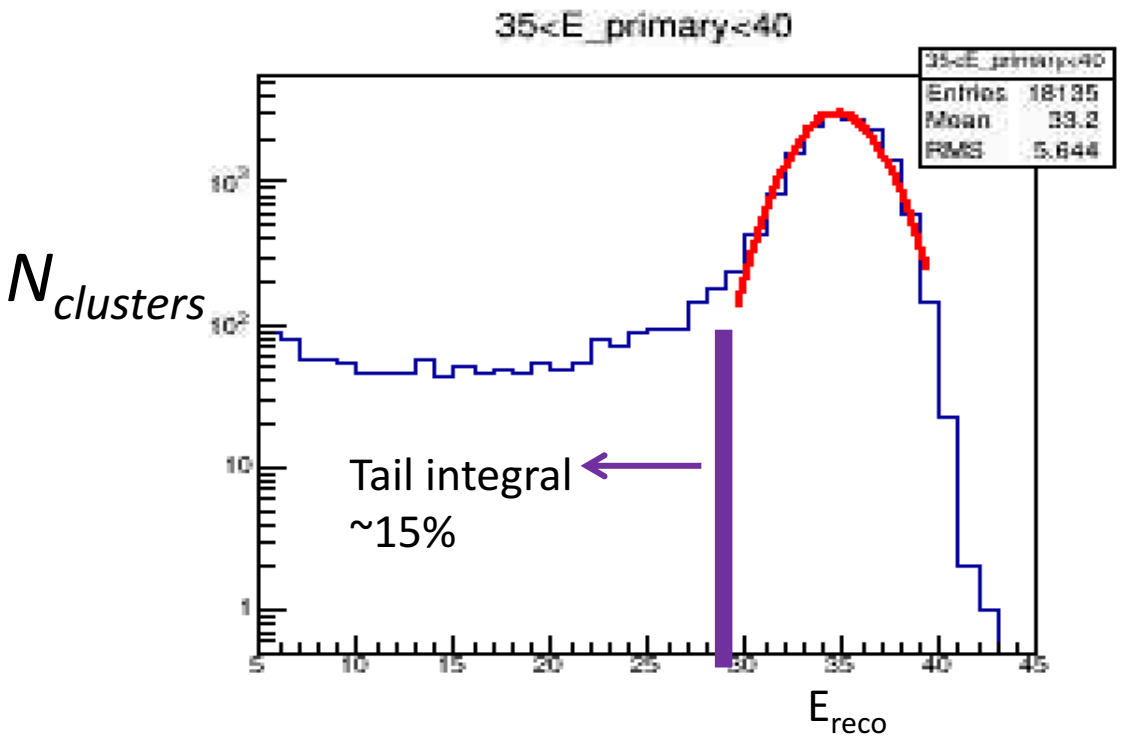
At High Etruth after the cut the remaining clusters are about 1.5%

Lower at low pt

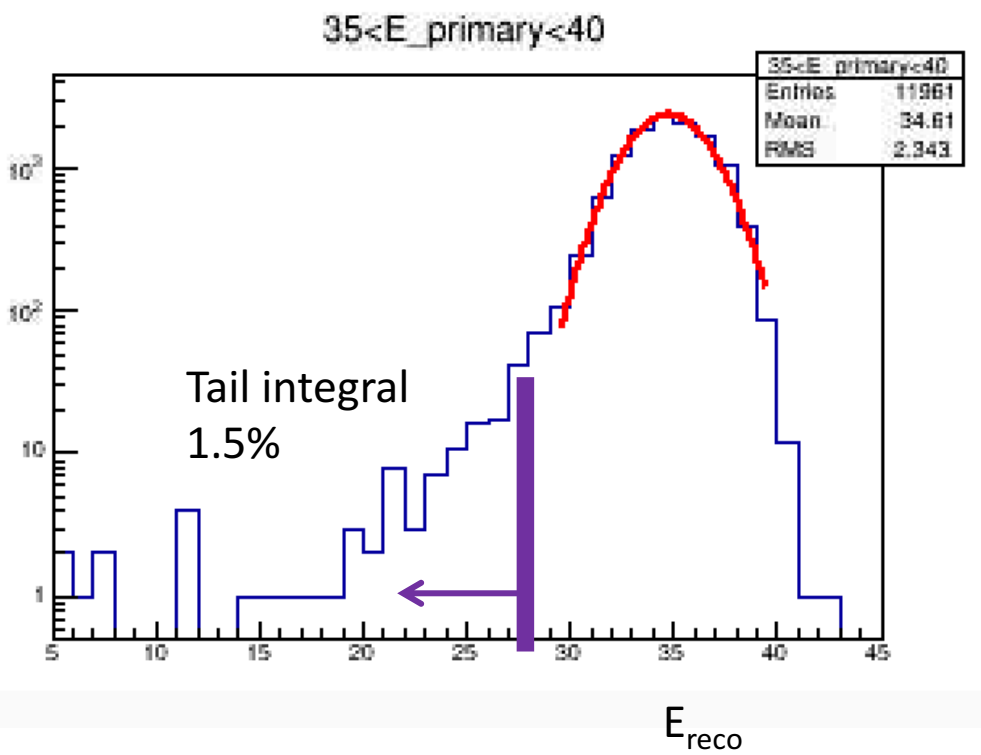
Low E cluster E_{reco} Distribution at High E_{γ}

-Truth photons between 35-40 GeV

Before fiber exclusion cut



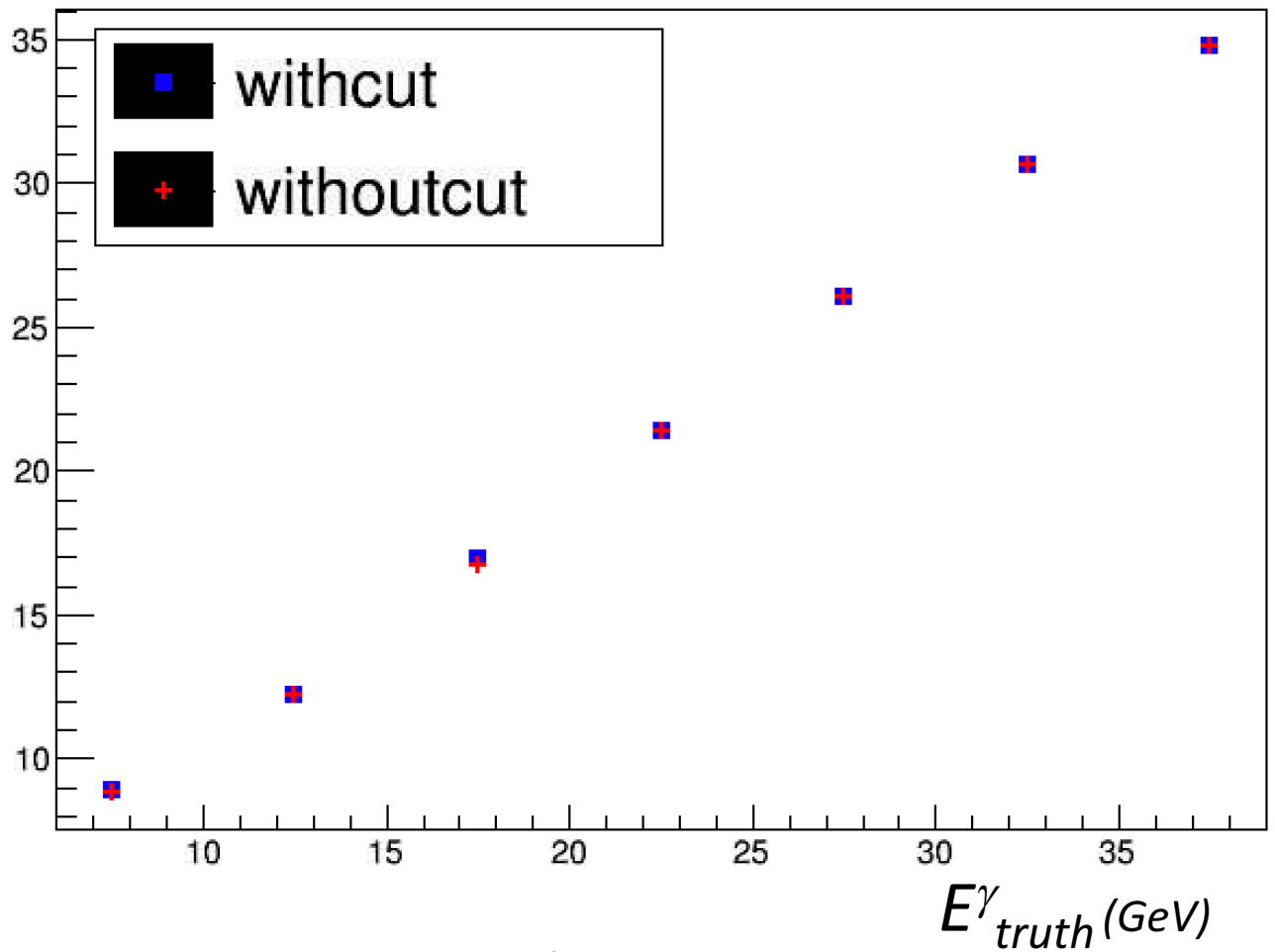
With cut



Fit mean Cut vs No Cut

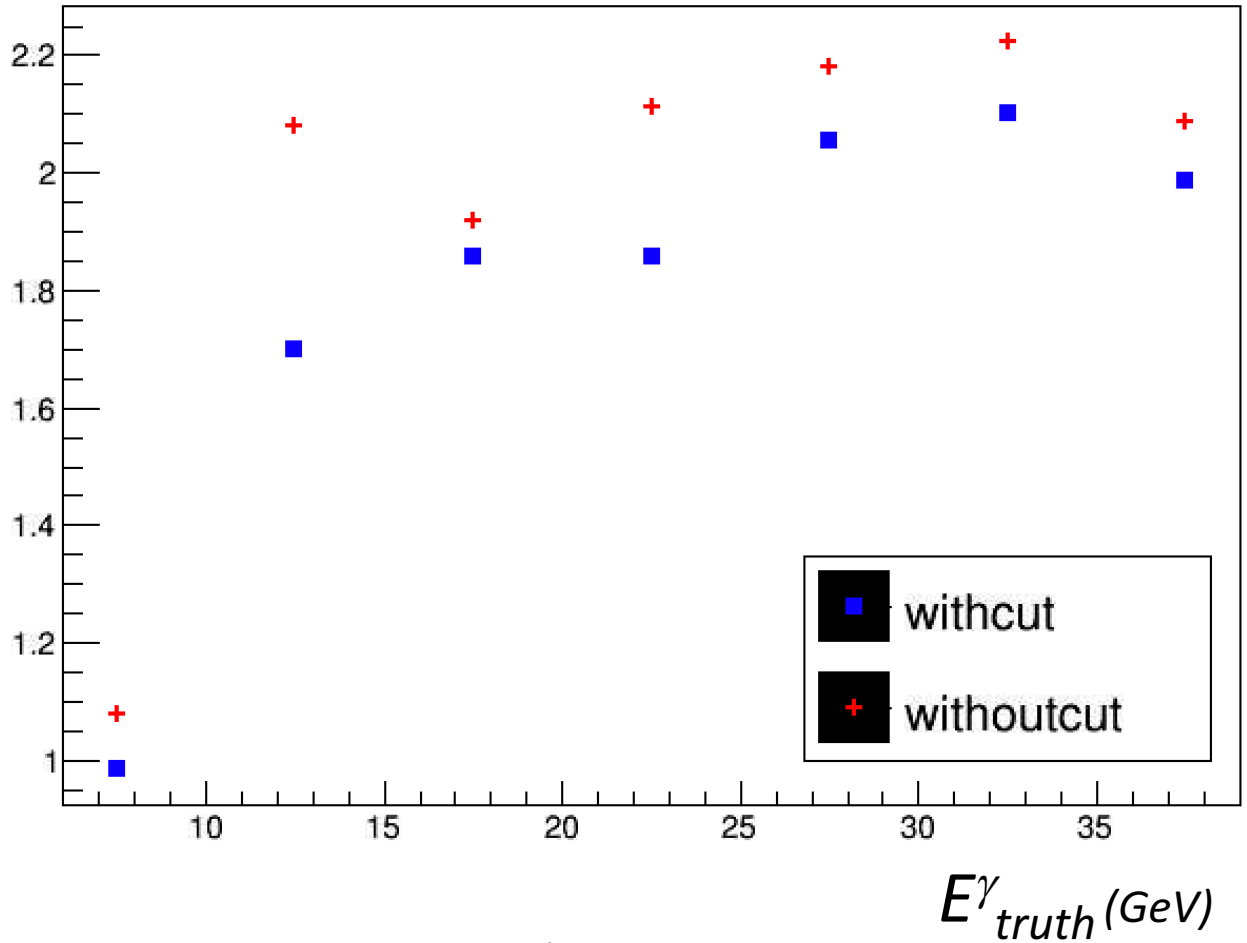
-Mean in peak area is hardly affected

Gaus
Fit
Mean (GeV)



Fit sigma

-Small change in Fit Sigma with and without cut



Conclusions Outlook

- Most low E cluster seem to be due to fiber channeling
- Will expand study to see effect of tower sector borders